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RNIA—THE RESOURCES AGENCY

RONALD REAGAN, Governor

CONSERVATION
OF MINES AND GEOLOGY
QUARTERS
RESOURCES BUILDING, ROOM 1341
1416 NINTH STREET
SACRAMENTO, CA 95814

District Offices: LOS ANGELES
Junipero Serra Bldg., Rm. 1065
107 South Broodwoy
90012

SACRAMENTO
Resources Bldg., Rm. 118
1416 Ninth Street
95814

SAN FRANCISCO
Ferry Building
94111

SEPTEMBER 1, 1972

Hon. James G. Stearns
Director of Conservation
Sacramento, California

Dear Director Stearns:

Here, for transmittal to Governor Ronald Reagan, is the 65th Report of the State Geologist, summarizing the work of the California Division of Mines and Geology for fiscal 1971-72.

The Division continued to increase its capabilities and activities in the field of seismology. Much effort went into cooperative programs with Counties, Cities, and agencies of the State and Federal governments. Details of these projects are given in the final sections of the report. Of especial note is further progress on the California Urban Geology Master Plan. Phases I and II were completed this year; next fiscal year should see publication of the Plan.

Marine Geology, a relatively new effort for the Division of Mines and Geology, is beginning to show some tangible products. An offshore bottom lithology reconnaissance map with a bathymetric base for the entire California coast was essentially complete at year's end. Publication will proceed as rapidly as possible.

Gross expenditures by the Division increased slightly but at a rate lower than the inflationary trend; net expenditures were less than the previous year because of reimbursements.

I hope you will be pleased with our progress.

Respectfully,

Wesley G. Bruer

Wesley G. Bruer
State Geologist

STATE OF CALIFORNIA—THE RESOURCES AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
DIVISION HEADQUARTERS
RESOURCES BUILDING, ROOM 1341
416 NINTH STREET
SACRAMENTO, CA 95814

District Offices: LOS ANGELES
Junipero Serra Bldg., Rm. 1065
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State Geologist

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TATE OF CALIFORNIA—RESOURCES AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION

IVISION OF FORESTRY
IVISION OF MINES AND GEOLOGY
IVISION OF OIL AND GAS
IVISION OF SOIL CONSERVATION

SACRAMENTO, CALIFORNIA
1416 Ninth Street

September 1, 1972

Hon. N. B. Livermore, Jr.
Secretary for Resources
The Resources Agency
Sacramento, California

Dear Mr. Livermore:

Here, for your presentation to Governor Ronald Reagan, is the 65th Report of the State Geologist, Wesley G. Bruer.

This report details the work of the California Division of Mines and Geology for fiscal 1971-72. The emphasis has continued to be on the safety of the citizens of the state from geologic hazards. I think you will find the Division's work in urban geology particularly commendable.

Respectfully,

James G. Stearns, Director

SIXTY-FIFTH REPORT OF THE STATE GEOLOGIST

ACTIVITIES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

JULY 1, 1971, THROUGH JUNE 30, 1972

Wesley G. Bruer, State Geologist
California Division of Mines and Geology
The Resources Building, Sacramento

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION

THE RESOURCES AGENCY
DIVISION OF MINES AND GEOLOGY

U.C.D. LIBRARY

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MISSION AND OBJECTIVES

The objective of the Division is to meet the geologic and mineral resources needs of California on a priority basis in cooperation with other public agencies and the private sector.

More formally stated, the mission of the Division is to collect, develop, and disseminate geologic information and actively encourage the application of a broad, useful understanding of the geology of California in cooperation with other agencies and the private sector; to thereby advise and assist in the wise management of the earth's crust, including its terrain and its mineral resources, as a service to the safety, economy, and enjoyment of the people of the State.

In so doing, it is the further objective of this Division to establish and maintain the standard of excellence for similar organizations throughout the world.

STATUTORY AUTHORITY

The Division operates under the authorities set forth in Chapter 2 of Division 1 and Chapters 1 and 2 of Division 2 of the Public Resources Code. The significant sections are summarized here:

Section	Substance of Law
601, 607	Establishes Department of Conservation in the Resources Agency, and Division of Mines and Geology and three other Divisions in the Department of Conservation.
660-667	Establishes State Mining and Geology Board and its responsibilities.
680	Establishes State Geologist as Chief of Division.
2201	State Geologist shall employ geologists and qualified specialists to do Division's work.
2203	State Geologist shall submit an annual report.
2204	State Geologist may receive and manage gifts on behalf of State.
2205	State Geologist may:
	Study mineral resources, mineral industries, and geology of the state.
	Collect mineral statistics.

Section	Substance of Law
2205	Collect geological and mineralogical specimens and models to constitute Division's exhibits.
	Provide technical library to be Division's library.
	Maintain, in effect, a bureau of information on the state's mineral industries.
	Conduct studies of geologic hazards in urban areas, including activities under cooperative agreements.
	Maintain a laboratory to perform physical and chemical tests and analyses.
	Issue reports and maps on the geology of the state and the statistics and technology of the state's mineral industries.

STATE MINING AND GEOLOGY BOARD

This Board, which is within the Department of Conservation, consists of nine members, seven of whom are "associated with or having broad knowledge of the mineral industries of this state, of its geologic resources, or of related technical and scientific fields..." and two of whom shall be members of the public having an interest in and knowledge of the environment.

The Public Resources Code states that "The Board shall represent the State's interest in the development, utilization, and conservation of the mineral resources of the state and in the development, collection, collation, and dissemination of geological information necessary to the understanding and utilization of the state's terrain and information pertaining to earthquake and other geologic hazards. It may establish policies conforming to the provisions of State statutes to govern the administration of the Division of Mines and Geology." The Board reviews Division policies and programs from time to time at its meetings.

The State Geologist, who serves as Chief of the Division, is "appointed under provisions of the State Civil Service Act by the Director (of the Department of Conservation) upon nomination by the Board."

During fiscal 1971-72, the Board met: September 14 in San Francisco
November 9 in Los Angeles
December 13 in San Francisco
January 25 in Los Angeles
February 10 in Los Angeles
April 11 in San Francisco
June 13 in San Francisco

During fiscal 1971-72, the Board:

...adopted a policy that there be an annual review of the Board's leadership and imposed a two-year limit on holding an office.

...re-elected Mr. Brovelli, Chairman; Dr. Jahns, Vice-Chairman; and Mr. Jensen, Secretary.

...worked with the Mining Plan Subcommittee in the development of the seventh draft of the State Mining and Mined Lands Reclamation Plan and assisted in the development, only partially completed, of the eighth draft.

...heard and accepted the results of the State Mining Law Workshop that led to the introduction and subsequent passage of AB 901 making technical changes in California statutes relating to mining claims.

...reviewed progress reports relating to the State's Strong Motion Instrumentation Program, passed as SB 1374. Board represented on the Advisory Board to the Program.

...reviewed reports relating to the formation of and the progress of the Governor's Earthquake Council. The Board is represented on the Council.

...reviewed reports on the progress of the Joint Legislative Committee on Seismic Safety.

...reviewed the Division's geologic hazards activities, especially the activities of the staff following the San Fernando earthquake of February 9, 1971.

...made conducted field trips to sand and gravel operations in southern California and to the proposed phosphate rock operation in Ventura County.

...adopted a resolution congratulating the leadership and staff of the Division of Mines and Geology for their outstandingly effective response to the San Fernando earthquake.

...reviewed a report from the Board's Geologic Hazards Subcommittee on an appraisal of the lessons learned from the San Fernando earthquake.

Governor Reagan reappointed Members Bradley and Henshaw for another four-year term.

Board Members	Current Term*	First Appointed
EDMOND F. BROVELLI, Chairman President, Basalt Rock Company Post Office Box 2540 Napa 94558	1971-75	1962
DR. CLARENCE R. ALLEN Seismological Laboratory California Institute of Technology Post Office Bin 2--Arroyo Annex Pasadena 91109	1969-73	1969
PHILIP R. BRADLEY 2801 Oak Knoll Terrace Berkeley 94705	1972-76	1943
DR. JOSEPH E. HARING Economics Department Occidental College Los Angeles 90041	1971-75	1971
DR. PAUL C. HENSHAW Homestake Mining Company 650 California Street San Francisco 94108	1972-76	1968
DR. RICHARD H. JAHNS, Vice Chairman School of Earth Sciences Stanford University Stanford 94305	1970-74	1966
J. WILMAR JENSEN, Secretary Jensen & Pendergrass 1514 H Street Modesto 95354	1971-74	1971
EUGENE R. REID Occidental Petroleum Corp. 5000 Stockdale Highway Bakersfield 93309	1971-75	1971
KARL V. STEINBRUGGE Insurance Services Office 465 California Street San Francisco 94104	1969-73	1969

*Terms of members as set forth in California Public Resources Code, Division 1, Chapter 2, Section 662.

ADMINISTRATION AND ORGANIZATION

Minor adjustments were made in the basic organizational structure of the Division in 1971-72. Reorientation of the Division Program from five to two operational elements eliminated the need for the formal "Element Coordinator" concept within the Program Group. Minor adjustments made to simplify and improve efficiency of administrative operations were the placing of the Technical Service Groups under the supervision of the Districts and the assignment of the administrative function of Assistant to the Chief to the full headquarters staff position of Support Services Officer. State Geologist Wesley G. Bruer was relieved of his temporary additional duties as State Oil and Gas Supervisor on November 2, 1971, and returned to the Division full time.

A continuing greater emphasis was placed on seismic studies with expanding activities in crustal strain investigation. Additional staffing authorized for these studies, provided by intradepartmental augmentation, included two additional seismologist positions, two additional Junior Geologist positions, and one additional Geologic Aid position.

Implementation of the Strong Motion Instrumentation Program, as mandated by Chapter 1152 of the Statutes of 1971, resulted in the addition of special project staff. At present, this specially funded staff consists of a geophysicist, with additional positions for geologist and stenographer to be filled later.

APPROVED
N. B. Livermore Jr.
SECRETARY FOR RESOURCES
August 20, 1970
DATE

STATE OF CALIFORNIA
THE RESOURCES AGENCY
AUGUST 1970

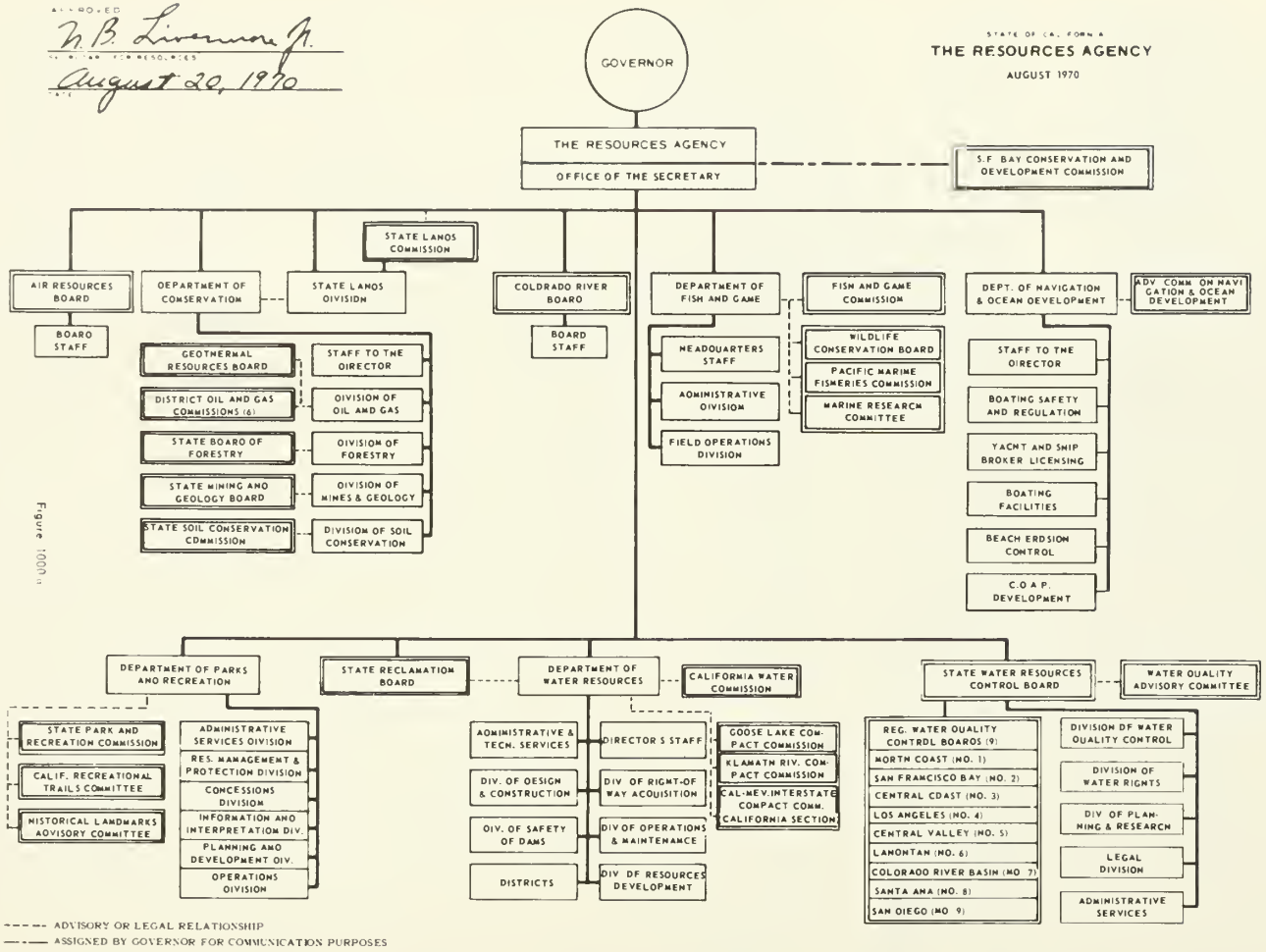
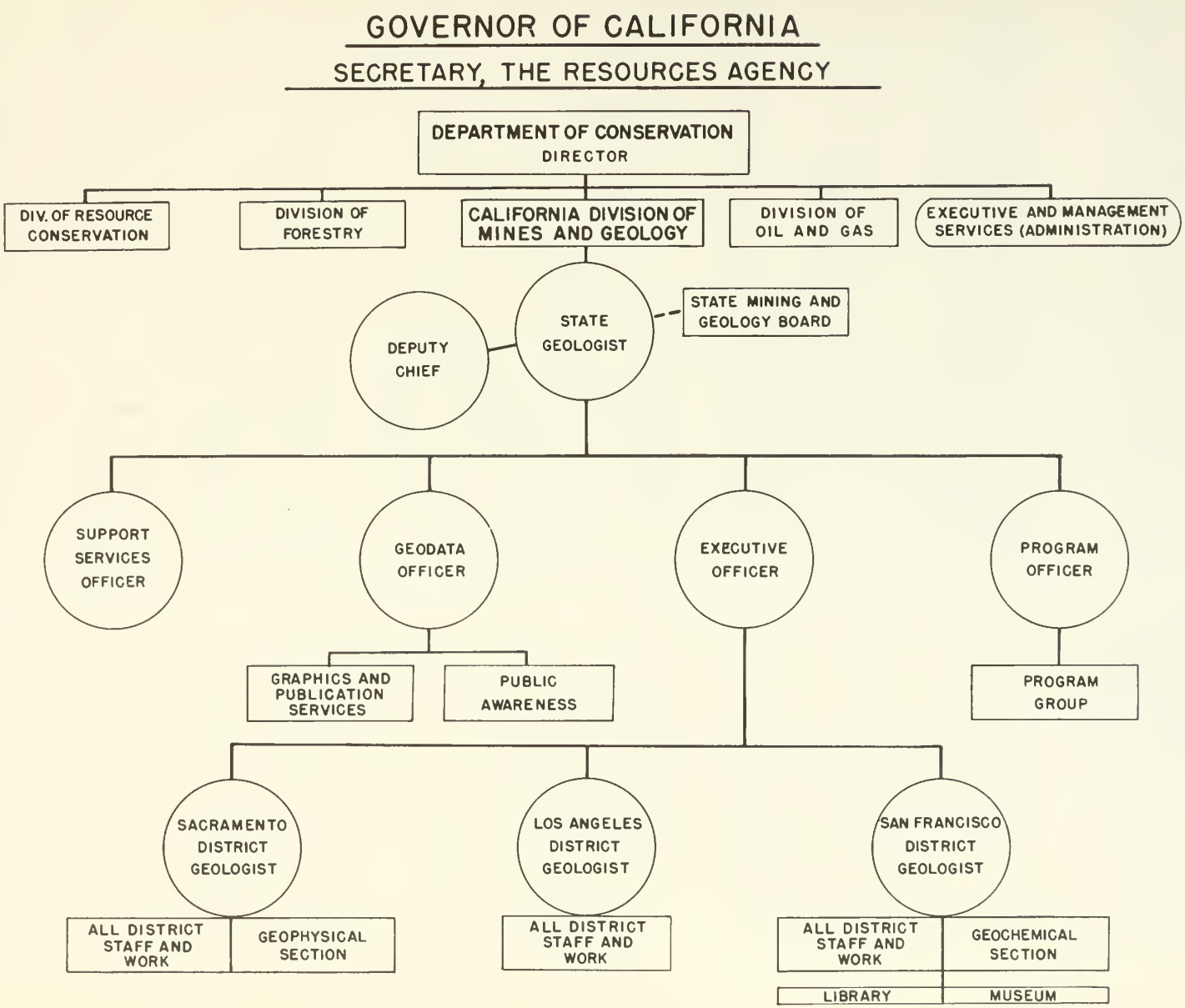


Figure 1000-1

----- ADVISORY OR LEGAL RELATIONSHIP
—·— ASSIGNED BY GOVERNOR FOR COMMUNICATION PURPOSES

ORGANIZATION
CALIFORNIA DIVISION OF MINES AND GEOLOGY
JUNE 1, 1972



PERSONNEL

Wesley G. Bruer is the State Geologist and Chief of the California Division of Mines and Geology. He is assisted by his executive staff--the Deputy Chief, the Executive Officer, the Program Officer, the Geologic Data Officer, and the Support Services Officer. In addition, permanent Division staff is comprised of 39 geologists, 2 geochemists, 3 geophysicists, 2 seismologists, 1 marine geologist, and 37 supporting technical, editorial, and clerical personnel.

HIRED

Senior Geologist	Thomas E. Gay, Jr., returning from two-year training leave with the Department of Navigation and Ocean Development.
Junior Geologist	Richard D. Knox.
Associate Geochemist	Glenn A. Borchardt.
Associate Geophysicist	William M. Wells.
Special Consultant	Donald A. Rodgers, Seismologist.
Geologic Aid	Russell V. Miller; John S. Rapp.
Delineator	Elizabeth M. Lindgren.
Clerk-Typist	Sharon L. Bly.
Stenographer	Sharon M. Burton; Jean E. Holmes; Laura M. Patrick.

SEPARATED

Supervising Geologist	Bennie W. Troxel, one-year training leave.
Geologic Aid	Patrick D. Caldwell; Bert W. Jeffries.
Laboratory Technician	Stanley T. Tsuchiya (deceased).
Drafting Aid	Alexander Eng.
Clerk-Typist	Myra C. Hsiung (retired); Susan K. Intfen; Suzanne E. Mashek.
Stenographer	Laura M. Patrick (deceased); Robyn L. Roles.

PROMOTED

Supervising Geologist	James B. Koenig.
Associate Geologist	James E. Kahle, Michael E. Huffman, Tom M. Wootton.
Junior Geologist	Russell V. Miller, John S. Rapp.
Publications Supervisor	R. Merl Smith.
Secretary I	Mary Louise Burgess.

REASSIGNED

Richard M. Stewart, Senior Geologist, was assigned to serve as District Geologist, San Francisco.

Tom M. Wootton, Associate Geologist, was assigned to serve as Support Services Officer.

TRANSFERRED

Headquarters.	James B. Koenig, Senior Geologist; William B. Clark, Associate Geologist; Carl J. Hauge, Assistant Geologist.
Sacramento District	Quintin A. Aune, Assistant Geologist; C. Forrest Bacon, Assistant Geologist.
San Jose Field Office . . .	Thomas H. Rogers, Associate Geologist.

TEMPORARY EMPLOYEES

The Division has participated in the various federally and State-funded student aid programs throughout the year. At one time or another, the Division has utilized the services of eight College Work-Study students and thirteen Neighborhood Youth Corps students.

In addition, two Student Assistants were employed on a temporary, non-paid basis for special studies, and one Seasonal Clerk was employed for two weeks to fill a gap in the Work-Study Program.

F. Beach Leighton, a geological consultant, was employed for a three-month period as a Special Consultant for a special study related to the Urban Geology Master Plan program.

Yvor M. Smitter, Geologist, and Michael F. Mills, Geologic Aid, were employed under the PEP program to work with the Division from February through the fiscal year.

PERMANENT DIVISION STAFF MEMBERS ON JUNE 30, 1972

EMPLOYEE	CLASSIFICATION	HEADQUARTERED
Wesley G. Bruer	State Geologist	Headquarters
Gordon B. Oakeshott	Deputy Chief	Headquarters
James B. Koenig	Supervising Geologist--Exeeutive Officer	Headquarters
John T. Alfors	Senior Geologist--Program Offieer	Headquarters
Mary R. Hill	Senior Geologist--GeoData Offieer	Headquarters
Cliffton H. Gray, Jr.	Senior Geologist--Distriet Geologist	Los Angeles
Riehard M. Stewart	Senior Geologist--Distriet Geologist	San Franeiseo
Rudolph G. Strand	Senior Geologist--Distriet Geologist	Saeramento
Tom M. Wootton	Assoeiate Geologist--Support Serviees Offieer	Headquarters
Rodger H. Chapman	Senior Geologist	Saeramento
Charles W. Chesterman	Senior Geologist	San Franeiseo
George B. Cleveland	Senior Geologist	San Luis Obispo
Fenelon F. Davis	Senior Geologist	Headquarters
Thomas E. Gay, Jr.	Senior Geologist	Headquarters
Charles W. Jennings	Senior Geologist	San Franeiseo
Bennie W. Troxel	Senior Geologist	On leave
Edward E. Welday	Senior Marine Geologist	San Franeiseo
Charles C. Bishop	Assoeiate Geologist	San Franeiseo
John L. Burnett	Assoeiate Geologist	Headquarters
William B. Clark	Assoeiate Geologist	Headquarters
James R. Evans	Assoeiate Geologist	Los Angeles
Earl W. Hart	Assoeiate Geologist	San Franeiseo
Miehael E. Huffman	Assoeiate Geologist	San Franeisco
James E. Kahle	Assoeiate Geologist	Los Angeles
Frederie R. Kelley	Assoeiate Geologist	San Franeiseo
Robert A. Matthews	Assoeiate Geologist	On leave
Douglas M. Morton	Assoeiate Geologist	Los Angeles
Paul K. Morton	Assoeiate Geologist	Tustin
Salem J. Riee	Assoeiate Geologist	San Franeiseo
Thomas H. Rogers	Assoeiate Geologist	San Jose
Riehard B. Saul	Assoeiate Geologist	Los Angeles
Melvin C. Stinson	Assoeiate Geologist	San Franeiseo
Robert Streitz	Assoeiate Geologist	Saeramento
F. Harold Weber, Jr.	Assoeiate Geologist	Los Angeles
Glenn A. Borehardt	Assoeiate Geoehemist	San Franeiseo
Hasmukhrai H. Majmundar	Assoeiate Geoehemist	San Franeiseo
John H. Bennett	Assoeiate Geophysieist	Sacramento
Gordon W. Chase	Assoeiate Geophysieist	Saeramento
Roger W. Greensfelder	Assoeiate Seismologist	Saeramento
Quintin A. Aune	Assistant Geologist	Saeramento
C. Forrest Baeon	Assistant Geologist	Saeramento
Allan G. Barrows, Jr.	Assistant Geologist	Los Angeles
William J. Edgington	Assistant Geologist	Tustin
Donald L. Fife	Assistant Geologist	Tustin
Carl J. Hauge	Assistant Geologist	Headquarters
Miehael P. Kennedy	Assistant Geologist	San Diego
Edmund W. Kiessling	Assistant Geologist	Los Angeles
Riehard D. Knox	Junior Geologist	San Franeiseo
Russell V. Miller	Junior Geologist	Los Angeles
John S. Rapp	Junior Geologist	Sacramento
John W. Williams	Junior Geologist	San Franeiseo
Lydia Lofgren	Laboratory Technician	San Franeiseo
Charles B. Smith	Laboratory Technician	San Franeiseo
Charles F. Armstrong	Geologie Aid	San Franeiseo
Trinda L. Bedrossian	Geologie Aid	Headquarters

PERMANENT DIVISION STAFF MEMBERS ON JUNE 30, 1972

EMPLOYEE	CLASSIFICATION	HEADQUARTERED
Duane A. McClure	Geologic Aid	San Francisco
R. Merl Smith	Publications Supervisor	Headquarters
Edward L. Foster	Geological Draftsman	Headquarters
Richard R. Moar	Geological Draftsman	San Francisco
Jeffrey O. Tambert	Geological Draftsman	Headquarters
Richard T. Boylan	Delineator	Headquarters
Elizabeth M. Lindgren	Delineator	Los Angeles
Vivian W. Muston	Delineator	Headquarters
Ronald L. Morgan	Graphic Artist	Headquarters
Dorothy Y. Fong	Drafting Aid II	Headquarters
LeVern W. Cutler	Senior Librarian	San Francisco
Mary E. Roche	Library Technical Assistant	San Francisco
Mary Louise Burgess	Secretary I	Headquarters
Dorris P. Campbell	Senior Stenographer	Headquarters
Josephine M. Territo	Senior Stenographer	San Francisco
Eleanor M. Learned	Senior Information Clerk	San Francisco
Wilma L. Ashby	Senior Clerk-Typist	Los Angeles
Gloria Tomei	Senior Clerk-Typist	Sacramento
Allen W. Lasley	Senior Clerk	San Francisco
Sharon M. Burton	Stenographer II	Headquarters
Marilyn F. Dayton	Stenographer II	Headquarters
Jean E. Holmes	Stenographer II	Headquarters
Jacqueline R. Jann	Stenographer II	San Francisco
Margaret W. Turner	Stenographer II	Headquarters
Sharon L. Bly	Clerk-Typist II	Sacramento
Catherine A. Govaller	Clerk-Typist II	Los Angeles
Andrew C. Love	Janitor	San Francisco

STAFF MEMBERS ON TEMPORARY ASSIGNMENT JUNE 30, 1972, PENDING COMPLETION OF APPROPRIATE EXAMINATIONS

EMPLOYEE	CLASSIFICATION	HEADQUARTERED
William M. Wells	Associate Geophysicist	Sacramento
Donald A. Rodgers	Associate Seismologist	Sacramento

DISTRICTS

LOS ANGELES

The Los Angeles District office serves the counties of Inyo, Kern, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside, San Diego, and Imperial. While the present emphasis of the District's activities is on geologic conditions potentially hazardous to the works of man, work is also being done in mineral resources and basic geology.

The District is staffed by 14 geologists, 1 draftsman, and 2 secretaries with field offices in Los Angeles, San Diego, Riverside, San Luis Obispo, Tustin, and University of California at Los Angeles.

The Los Angeles District headquarters office also maintains a library with special emphasis on geologic hazards and an effective small mineral exhibit.

SACRAMENTO

The Sacramento District office helps to meet the geologic needs of the people of the 30 counties of central and northeastern California. It is also the base for the Division's Geophysical and Seismological Sections, which have statewide responsibilities.

A major part of the geologic effort this year has been to provide information to cope with actual or potential mine waste water pollution. This activity will assist in the massive effort needed to clean California's waterways and will aid the mining industry to minimize its environmental impact while continuing to operate.

The Geophysical Section made a significant contribution by locating obscure subsurface extensions of the fault that was activated during the San Fernando earthquake of 1971. In another study of statewide extent, the analysis of gravity data has resulted in further knowledge of the crust beneath the surface. Such information is fundamental to a better understanding of crustal structures such as faults and to the identification of the subsurface extent of ore-related rock masses.

The newly established Seismological Section has responded on several fronts to the concern for life and property threatened by earthquakes. Strain accumulation is being measured, and tiltmeters have been installed at three locations in hopes of identifying a precursory phenomenon. The Strong-Motion Instrumentation Program has commenced, with several sites having been acquired and the first of ten instruments readied for installation at year's end. A start was made on the preparation of a comprehensive catalog of California earthquakes. While all members of the staff have spent a considerable part of their time in providing information to local government and to the legislative and administrative branches of State government, the seismological staff has been called upon most frequently to assist in the formulation of State programs to cope with the serious earthquake hazard that confronts California.

SAN FRANCISCO

The San Francisco District Office, which has been housed in the historical landmark, the Ferry Building, since 1896, covers a working territory of 17 counties in northern and central coastal California. This includes approximately two-thirds of the California seacoast, most of the central and northern Coast Ranges, and much of the very active San Andreas and related faults.

This District Office has many facets—Geochemical Laboratory; Marine Geology Section; the Map Room, which compiles and prepares various maps such as the Geologic Map of California series; a large and complete technical reference library; and one of the largest mineral exhibits on the West Coast.

Many cooperative projects with various San Francisco Bay Area Counties and the U.S. Geological Survey have been undertaken by this office. The main emphasis is on geologic hazards and seismic safety.

The Library-Museum has over 1000 visitors a month seeking information—on mines, minerals, geologic hazards, rock identification, and mining law—or studying the vast mineral collection.

The District staff is comprised of 15 geologists, 2 geochemists, 3 laboratory technicians, 1 draftsman, 2 librarians, 3 secretaries, 2 information clerks, and 1 janitor. There are two field offices, one in San Jose and one in Santa Rosa.

GEOLOGIC HAZARDS AND MINERAL RESOURCES CONSERVATION PROGRAM

ENVIRONMENTAL AND ECONOMIC GEOLOGY ELEMENT

Geologic Hazards

In the interest of public safety, the Division is concentrating on areas in the geologic environment that are being considered for urban development. This will allow public agencies and private planners, developers, and builders to become aware of the geologic conditions which much be taken into account—including such existing and potential hazards as landslides, active faults, rapid erosion, and subsidence. Assistance—in the form of cooperative agreements which include sharing costs with local governmental agencies, other State agencies, and Federal agencies—enables the Division to work on a far broader front than would otherwise be possible. This is discussed in greater detail in the section on Cooperative Activities. Three categories are included in this part of the program: Urban Mapping Projects, Special Problems in Environmental Geology, and Seismic and Fault Movement Investigations.

Basic Geology

No geologic efforts of the Division can progress far without relying upon fundamental scientific information. These "basic geology" studies are designed to determine the general geologic framework of California, the properties of crustal materials, the geologic processes responsible for the distribution and configuration of various rock units and mineral resources, and the geologic processes responsible for the seismic adjustment of various rock units.

Geochemistry

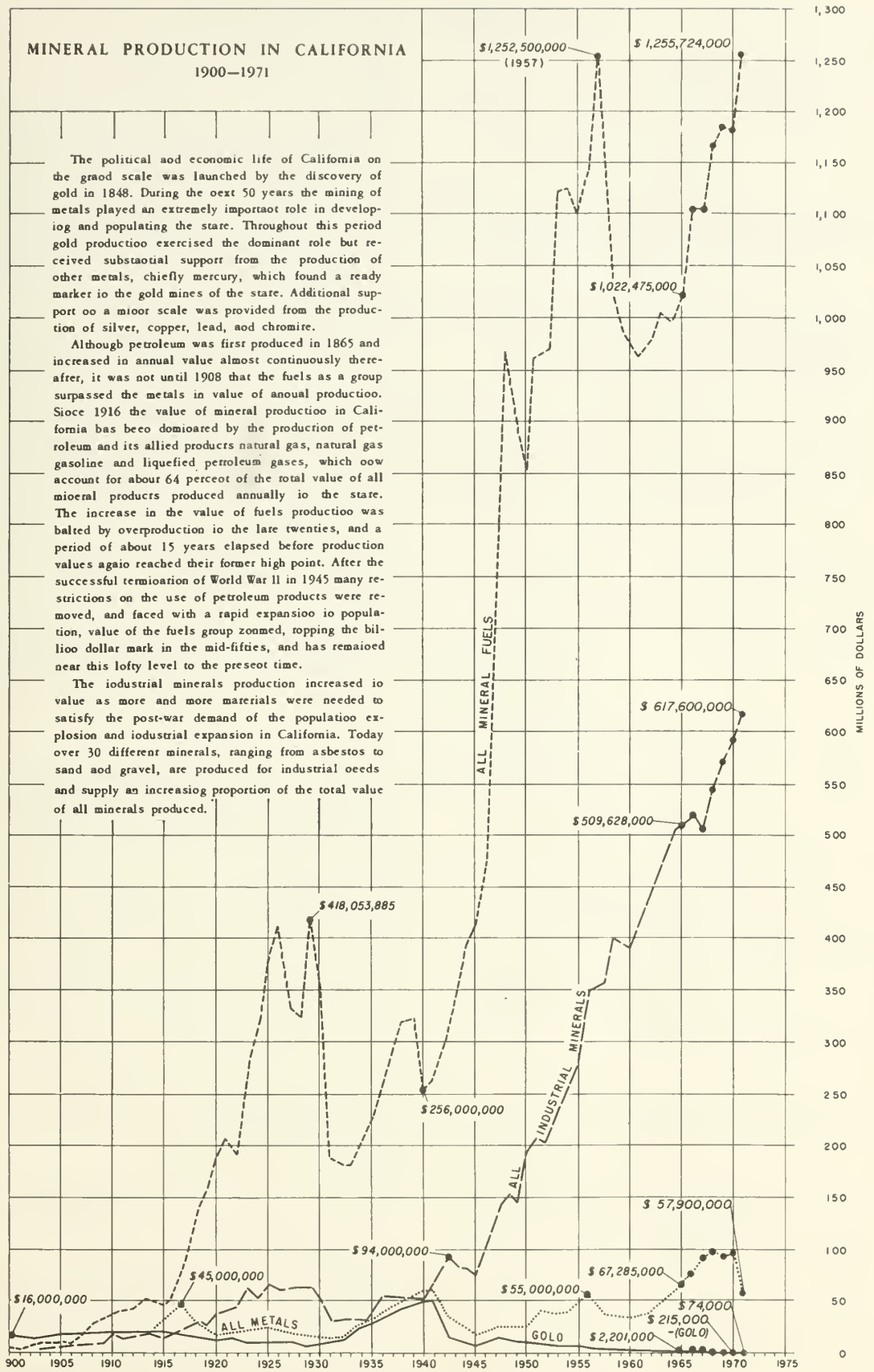
The primary mission of the Geochemical Laboratory is to provide geochemical support to other Division activities. In order to provide the best technical service for a wide variety of Division projects, the geochemical staff is developing new laboratory procedures for doing many kinds of tests.

Mineral Resources

The Division assists in meeting mineral resources demands by planned investigation and delineation of new mineral deposits and by development of more efficient field and laboratory techniques. In addition to the principal active projects, the Division has been involved in studies concerning factors which affect mineral production in California, such as mine waste-water discharge, mine and mill waste for construction use, and legislation relevant to land use problems and the wise development of the state's mineral resources.

Marine Geology

The study of marine geology is the extension of the themes of geologic hazards, basic geology, and mineral resources into the marine environment. The major efforts in this area in fiscal 1971-72 were to complete a comprehensive sea-floor lithologic map for the entire California coastal area. Although the map was prepared principally by compiling and interpreting existing data, additional new samples and data were acquired during the year.


MINERAL PRODUCTION IN CALIFORNIA
1900—1971
The political aod economic life of Califomia on the graod scale was launched by the discovery of gold in 1848. During the oext 50 years the mining of metals played an extremely importaot role in developiog and populating the state. Throughout this period gold productioo exercised the dominant role but received substaotial support from the production of other metals, chiefly mercury, which found a ready marker io the gold mines of the state. Additional support oo a mioor scale was provided from the production of silver, copper, lead, aod chromite.
Althougb petroleum was first produced in 1865 and increased in annual value almost continuously thereafter, it was not until 1908 that the fuels as a group surpassed the metals in value of anoual productioo. Sioce 1916 the value of mineral productioo in California bas beeo domioated by the production of petroleum and its allied products natural gas, natural gas gasoline and liquefied petroleum gases, which oow account for abour 64 perceot of the rotal value of all mioeral products produced annually io the state. The increase in the value of fuels productioo was halted by overproduction io the late twenties, and a period of about 15 years elapsed before production values agaio reached their former high point. After the successful termioation of World War II in 1945 many restrictions on the use of petroleum products were removed, and faced with a rapid expansioo io population, value of the fuels group zoomed, topping the billioo dollar mark in the mid-fifties, and has remaioed near this lofty level to the preseot time.
The iodustrial minerals production increased io value as more and more materials were needed to satisfy the post-war demand of the populatioo explosion and iodustrial expansion in California. Today over 30 different minerals, ranging from asbestos to sand aod gravel, are produced for industrial oeeds and supply an increasiog proportion of the total value of all minerals produced.
$1,252,500,000 (1957)
$1,255,724,000
$1,022,475,000
ALL MINERAL FUELS
$617,600,000
$509,628,000
$418,053,885
$256,000,000
ALL INDUSTRIAL MINERALS
$57,900,000
$94,000,000
$67,285,000
$45,000,000
$16,000,000
$55,000,000
$74,000
$215,000
ALL METALS
GOLD
$2,201,000
(GOLD)
1,300
1,250
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
MILLIONS OF DOLLARS
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975

URBAN MAPPING PROJECTS		
PROJECT	**STAFF**	**STATUS**
San Diego, city of	Kennedy	Mapping completed. Drafts of two reports (parts of six 7 1/2-minute quadrangles) completed.
Sonoma County	*Huffman*	*Completed field maps and preliminary reports; submitted to County and to CDMG for publication.*
Santa Cruz Mountains, Santa Clara County, 1970-71	*Rogers*	*Report published by the County; submitted for publication by CDMG.*
Santa Cruz Mountains, Santa Clara County, 1971-72	*Rogers, Armstrong*	*First phase of mapping completed.*
Marin County, various areas	*Rice, Strand*	*Maps and reports completed and submitted for publication.*
Carquinez quadrangle (Solano County), part	Bacon	Preliminary report in progress.
Ventura County, south half	*Weber, Mills, Cleveland, Miller, Kahle, Kiessling, D. Morton*	*Geologic map compilation completed. Reconnaissance map of major landslides by D. Morton completed.*
Orange County	*P. Morton, Fife*	*Selected areas mapped. Compilation of geologic map of County commenced. Landslide map 80 percent complete.*
Santa Cruz coastline study	Williams	In progress.
West central Mt. Wilson 7 1/2-minute quadrangle, Los Angeles County	*Saul*	*Report reviewed; being revised.*
East central Mt. Wilson and south half Azusa 7 1/2-minute quadrangles, Los Angeles County	*D. Morton*	*Report ready for printer as Special Report 105.*
Southeast quarter Mint Canyon 7 1/2-minute quadrangle, Los Angeles County	*Saul*	*Very limited amount of mapping continued.*
Southwest quarter Walnut Creek 7 1/2-minute quadrangle, Contra Costa County	Saul	Continued processing for publication as Map Sheet 16.
Northwest quarter Folsom 7 1/2-minute quadrangle, Sacramento County	Aune	Mapping completed; report in progress.

URBAN MAPPING PROJECTS *continued*		
PROJECT	**STAFF**	**STATUS**
South half Mt. Baldy and southwest quarter Glendora 7 1/2-minute quadrangles, Los Angeles County	*Streitz*	*Report to be revised.*
Southeast quarter Oat Mountain 7 1/2-minute quadrangle, Los Angeles County	*Saul*	*Mapping revised to include effects of San Fernando earthquake; area to be slightly enlarged.*
Southwest quarter Oat Mountain 7 1/2-minute quadrangle, Los Angeles County	*Evans*	*Mapping continued; southwest quarter 80 percent complete; area to be enlarged.*
Calabasas 7 1/2-minute quadrangle, Los Angeles County	*Weber*	*Mapping inactive.*
South half El Toro 7 1/2-minute quadrangle, Orange County	*Fife*	*Report reviewed and revised.*
Dana Point 7 1/2-minute quadrangle, Orange County	*Edgington*	*Report reviewed and revised.*
Thousand Oaks 7 1/2-minute quadrangle, Ventura County	Weber	Mapping inactive.
Cañada Gobernadora 7 1/2-minute quadrangle, Orange County	*P. Morton*	*Final compilation completed. Draft of report completed.*
San Juan Capistrano 7 1/2-minute quadrangle, Orange County	*P. Morton, Edgington, Fife*	*Mapping and draft of report completed.*
Laguna Beach 7 1/2-minute quadrangle, Orange County	*Edgington*	*Mapping commenced.*
Part of Juniper Hills 7 1/2-minute quadrangle, Los Angeles County	*Barrows*	*Mapping commenced.*

Projects in italics are cooperatively supported.

SPECIAL PROBLEMS IN ENVIRONMENTAL GEOLOGY		
PROJECT	**STAFF**	**STATUS**
Wrightwood mudflows	D. Morton	Report reviewed and being revised.
Wright Mountain landslide	D. Morton	Report revised to accompany paper on Wrightwood mudflows.
Landsliding in coastal regions of California	Cleveland	Field and office work continued; report underway.

SPECIAL PROBLEMS IN ENVIRONMENTAL GEOLOGY *continued*		
PROJECT	**STAFF**	**STATUS**
Erosion of Sunset Cliffs, San Diego County	Kennedy	Report completed for *California Geology.*
Quality requirements for mine waste water, under Porter-Cologne Act, 1969, a review	Davis, Streitz, Evans	Text revised.
U.S. Department of Housing and Urban Development (HUD)—California master plan for urban geology	*Staff*	*Report submitted.*
Thermal power plant siting	Koenig, Williams	Participated in various site evaluations.
Real estate tract reviews	*Kelley, Kiessling, Rice*	*For the Department of Real Estate (under contract).*
San Fernando earthquake	Oakeshott *et al.*	Bulletin in press.
Basin planning study, principal areas of mine pollution, mine data compilation	*Staff*	*For the State Water Resources Control Board (under contract): First phase completed.*

Projects in italics are cooperative ventures.

SEISMIC AND FAULT MOVEMENT INVESTIGATIONS		
PROJECT	**STAFF**	**STATUS**
Active faults, statewide	Kahle	Preliminary reconnaissance of south half of Ventura County completed.
San Andreas fault, San Bernardino area	D.Morton	Continued field work; draft of map sheet of Devore 7 1/2-minute quadrangle completed.
Calaveras fault, Hollister	*Bishop, McClure*	*Continued creep measurements.*
Newport-Inglewood fault zone	*Barrows*	*Report reviewed and revised.*
Earthquake damage analysis	Bishop, Kahle, Rogers	Made on-site investigations or several earthquakes.
San Fernando earthquake	*Los Angeles District staff*	*Completed geologic map, surface breaks map, and reports for Bulletin 196.*
Geodimeter program	*Bennett, Rodgers, Greensfelder*	*Continued field measurements and data analysis*
Tiltmeter program	Bennett, Bacon, Greensfelder	Three tiltmeters installed. First results being analyzed.

SEISMIC AND FAULT MOVEMENT INVESTIGATIONS *continued*		
PROJECT	**STAFF**	**STATUS**
Crustal strain investigations	Greensfelder	In press as Special Publication 37; map showing location of crustal strain activities.
San Fernando faults	Chase, Chapman	Magnetic studies of "active" faults; analysis and report in progress.
Green Valley fault, Solano County	Bishop	Reconnaissance started.
Micro-acoustic rock-strain monitoring	Bacon	Feasibility investigated and proposal approved.
Strong-motion instrumentation program	Wells, Bacon	Four sites selected and examined; arrangements made for installation of first instruments by State.
Catalog of California earthquakes	Greensfelder, Rodgers	Library research begun.
Mechanics of faulting in Transverse Ranges	Rodgers	Analysis of data and report in progress.

Projects in italics are cooperative ventures.

AREAL GEOLOGY PROJECTS		
PROJECT	**STAFF**	**STATUS**
Lakeview-Perris quadrangles	D. Morton	To press
Northeast Shoshone quadrangle	Chesterman	In press.
Haiwee Reservoir quadrangle	Stinson	Recessed; awaiting review.
Keeler quadrangle	Stinson	Recessed; awaiting review.
Bodie quadrangle	Chesterman, Gray	Continued processing for publication as Map Sheet.
San Luis Obispo area	Hart	First draft of manuscript completed.
Matterhorn Peak quadrangle	Chesterman	Continued processing for publication as Map Sheet
North half Confidence Hills quadrangle	Troxel, Wright*	Completed field map.
South half Chittenden and San Juan Bautista quadrangles	Bishop	Awaiting stratigraphic data.

*Former staff member, now with Pennsylvania State University.

GEOLOGIC MAPS		
PROJECT	**STAFF**	**STATUS**
Death Valley Sheet revision	Streitz	Compilations completed; report in progress.
State geologic planning map 1:750,000	Jennings, Burnett, Stinson	Continued compilation.
Index to geologic maps 1969	Kiessling	Compilation complete.
Index to geologic maps 1970	Kiessling	Compilation partly complete.

GEOPHYSICAL PROJECTS (OTHER THAN SEISMIC AND FAULT INVESTIGATIONS)		
PROJECT	**STAFF**	**STATUS**
Bouguer Gravity Map of California (1:25,000)	Chapman, staff	Weed manuscript and map submitted for publication; all remaining sheets in preparation. Kingman in press.
Bouguer Gravity Map of California (1:750,000)	Chapman	North half completed; south half in progress.
Ione geophysical study	Bishop, Chapman	Report in press.
Port Wine area study	Chapman, Clark	Completed interpretation of data; report in progress.
Aeromagnetic map of California (1:750,000)	Chase	Compiled available data.
Bodie Hills gravity	Chapman	Report in press on gravity anomalies in Bodie Hills area—to be published by U.S. Geological Survey.
Magalia gravity study (ground water supply for California Division of Forestry camp)	Chapman, Chase	Data collected; analysis of data and report in progress.
Staff support for the Governor's Earthquake Council	Bruer, Wootton, Greensfelder, Koenig, and others	Organizational phase completed; reports in progress.

GEOCHEMICAL PROJECTS		
PROJECT	**STAFF**	**STATUS**
Atomic absorption analysis of gold and silver	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Work in progress for development of analytical procedure.
Flameless atomic absorption analysis of mercury	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Developed procedure.
Mineral separation for potassium-argon age determinations	Majmundar, Lofgren, C. Smith, Tsuchiya	Separated biotite from other minerals in rocks.
Physical testing of soil samples	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Used physical tests on sedimentary materials (particle size distribution and Atterberg tests); bulk and clay mineralogy determined by x-ray diffraction.
Monterey basin geochemical background studies	*Majmundar, Lofgren, C. Smith, Tsuchiya*	*Work in progress for development of analytical procedure for mercury, arsenic, cadmium, lead, and boron determination in sediments.*
Sampling boat technique for atomic absorption analysis	Majmundar, Lofgren, C. Smith, Tsuchiya	Work in progress for development of procedures to determine heavy metals at the parts per billion level.
Water analysis	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Work in progress for development of analytical procedures for copper, lead, zinc, and chlorine.
Calcium cabonate determination	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Developed gasometric, gravimetric, and atomic absorption procedures.
X-ray diffraction analysis of clay minerals	Majmundar, Borchardt, Lofgren, C. Smith, Tsuchiya	Developed methods for relative humidity and cation saturation control for identifying clay minerals.
Computer program evaluation	Borchardt	Review programs and documentation for HUD project.
Landslide studies	Borchardt, Lofgren, C. Smith	Developed shear strength test, pH determination, and quantitative determination of montmorillonite, vermiculite, and amorphous material.

Projects in italics are cooperative ventures.

COUNTY MINERAL RESOURCE INVESTIGATIONS		
PROJECT	**STAFF**	**STATUS**
Riverside	Saul, Evans, Gray	Being revised.
Imperial	P. Morton	In process for publication.
Alpine	Clark	In press.
Shasta	Lydon, O'Brien*	In press.

**Former staff member, now retired*

COMMODITY INVESTIGATIONS		
PROJECT	**STAFF**	**STATUS**
Limestone and dolomite resources of California, introduction	Bowen*, staff	In press as Bulletin 194
Limestone, dolomite, and shell resources in the Coast Ranges Province	Hart	In press.
Limestone and dolomite resources of the Klamath Mountains Province	Evans	Undergoing revision.
Limestone and dolomite resources, Mojave Desert Province	Bowen*, Gray	In preparation.
Limestone and dolomite resources, Transverse Ranges Province	Gray	In preparation.
Mother Lode guidebook revision (formerly Bulletin 141)	Clark, Hill	In progress.
Simi conglomerate as source of concrete aggregate, Los Angeles	Kiessling	Map and report completed.
Silver, Calico silver district	Weber	Inactive.
Clear Lake geothermal areas geophysical study	Chapman, McNitt**	Analysis of data and report in progress.
Mine wastes as source of aggregate, north foothills of the Sierra Nevada	Clark	Part A completed.

COMMODITY INVESTIGATIONS *continued*		
PROJECT	**STAFF**	**STATUS**
San Francisco Bay Area minerals study	*Bishop, Burnett, Chesterman, Stewart, Stinson, Welday*	*Investigation completed.*
Geothermal resources of California	Bacon, Koenig	Prepared brief reports on several areas of the state for the Division of Oil and Gas

*Former staff geologist, now private consultant **Former staff geologist, now with the United Nations *Projects in italics are cooperative ventures.*

MARINE GEOLOGY PROJECTS		
PROJECT	**STAFF**	**STATUS**
Bottom lithology maps of offshore areas, Oregon to Mexico	Welday, Williams	Completed preliminary maps.
Bottom characteristics of San Francisco Bay	Welday, Williams, McClure	Collected and analyzed samples; prepared maps.
Bottom sediment characteristics of Mono Lake	Welday	Collected and analyzed samples.
Offshore surveys, southern borderland	Welday	Made seismic measurements; took samples.
Offshore surveys, central and southern coast	Welday	Study continuing on distribution of mercury, copper, lead, zinc, cadmium, chromium in sediments.
Monitoring of sand mines in Monterey and San Francisco Bays	*Welday*	*Study continuing.*

Projects in italics are cooperative ventures.

GEOLOGIC DATA ELEMENT

The objective of the Geologic Data Element is to provide the citizens of California with geologic information relevant to their lives and livelihoods. The Geologic Data staff compiles and disseminates the results of studies made by staff members of the California Division of Mines and Geology and others in the earth sciences profession. This is done in a variety of ways: by formal publications, by letter, by informal leaflets, by technical and semitechnical illustrated talks, and by personal contact.

The Division maintains three Information Desks, one at each of the District Offices, and, in San Francisco, a Museum and a Library to help relate the importance of geology to the safety, welfare, and economy of California.

Information Desks and Letters

The California Division of Mines and Geology is the principal organization in California from which a citizen can be assured an answer to an earth science question. The Geologic Data staff answers queries as completely as possible.

The rising price of gold on the open world market created an instant demand for information to be supplied by letter and in person. Bulletin 193 "Gold districts of California", a new "Gold pak" consisting of information published in *California Geology* and its predecessor *Mineral Information Service*, as well as "Geology of placer deposits", "Basic placer mining", various CDMG Notes, and the "Legal guide for California prospectors and miners"--all were of immediate help and interest to would-be gold seekers.

Two "public relations" displays--one in the San Francisco-Tiburon Ferry Ticket Office and one on the ramp in the World Trade Center--have increased traffic and sales at the San Francisco Information Desk about 15 percent.

Museum

The large cases containing minerals classified under the Dana System were painted under the continuing renovation program begun in 1967. All traces of the damage done by a bomb in the Department of Corrections have been erased; one wall case containing minerals and an irreplaceable old relief map were destroyed and there was quite a bit of broken glass where the wall case and the map fell on floor cases, but we will be reimbursed by the San Francisco City Port Authority.

Interest in the "rotating" displays by Bay Area mineral societies has increased. Each society is quite eager for its "turn" to come around, and the public's appreciation is very gratifying.

The tours led by the Senior Information Clerk are very popular, too. In addition to school children, she gets requests from senior citizen groups, classes of handicapped and retarded children, ambulatory patients from local military hospitals, and gem and mineral societies.

Library

The Division Library has undergone considerable renovation during the past year. The stacks have been rotated; the publications have been rearranged into a more usable order; the staff work area has been made more efficient; and stored material has been sorted.

Publications

The Geologic Data staff publishes and distributes the results of technical studies of California geology as promptly, concisely, attractively, and economically as practicable. The staff reviews the technical content of manuscripts, drafts illustrations, does cartography of the maps, processes the manuscript and map editorially, coordinates the printing and lithography, negotiates contracts, manages the printing budget, and supervises the distribution of the final printed report.

During fiscal 1971-72, revenue from sale of Division publications was $82,000.

Publications Released

Trace elements in the Plumas copper belt, Plumas County, California. Special Report 103. 26 pages, 1 plate, 11 figures, 5 photos, 8 tables. $3.00

Upper Cretaceous stratigraphy on the west side of the northern San Joaquin Valley, Stanislaus and San Joaquin Counties, California. Special Report 104. 29 pages, 2 plates, 17 fiugres. $5.00

Geology and mineral deposits of the Mescal Range [15-minute] quadrangle, San Bernardino County, California. Map Sheet 17. Map, expanded legend, cross sections, 8 tables. $1.50

San Luis Obispo sheet, Bouguer gravity map of California. Plate, data sheet, booklet. $2.00

List of available publications, January 1972. 33 pages, 3 figures.

Sixty-fourth report of the State Geologist. Issued in processed form.

Publications Reprinted

Basic placer mining. 1963. Third printing.

The elephant as they saw it. 1949. Fourth printing. $2.00

Fabricas. 1952. Second printing. $2.00

Bakersfield sheet)
Long Beach sheet)
Los Angeles sheet)
Sacramento sheet)
Santa Cruz sheet)
Santa Maria sheet)
Geologic map of California, Olaf P. Jenkins Edition. Plate and data sheet sold flat or folded in manila envelope. $1.50 each

Open File Reports Released

Analysis of mudslide risk in southern Ventura County. Prepared for U.S. Department of Housing and Urban Development, Federal Insurance Administration.

Geology for planning in the Sonoma Mountain and Mark West-Riebli Road areas, Sonoma County. A product of a cooperative agreement with the Sonoma County Planning Department.

Environmental geologic analysis of the Santa Cruz Mountain area, Santa Clara County. A product of a cooperative agreement with the Santa Clara County Planning Department.

Urban geology master plan for California. Phase I: a method for setting priorities. Prepared in cooperation with the U.S. Department of Housing and Urban Development.

Geologic and slope stability maps of the Tennessee Valley, Lucas Valley, and north coastal areas, Marin County, California. A product of a cooperative agreement with the Marin County Planning Department.

California Geology Major Articles

Geodimeter fault movement investigations in California.
Geology of the Lake Tahoe basin.
Volcanism in California.
California mining activity in 1970.
Cinder cone sewage disposal site at north Lake Tahoe.
Gold mine waste--a mineral commodity.
When the Earth quakes, you can reduce the danger.
Fossils--the living past.
Copper mining.
San Francisco Bay tidelands.
A centennial . . . the great Owens Valley earthquake of 1872.
Deep sea drilling project.
Urban ore . . . a new resource opportunity.
Diving for gold in California.
Engineering features of the San Fernando earthquake.
Mono Lake geothermal wells abandoned.
Left-lateral, east-trending faults in the Alabama Hills [Inyo County].

CDMG Notes

A number of these new information leaflets were released during the year. They have been very useful, particularly in the saving of time in providing answers to frequently asked questions. Those released in fiscal 1971-72 were:

Lands open to prospecting and location in California. 71-8
California Geology [subscription form]. 71-9, 72-9
Some sources of information on California earthquakes and faults. 71-10
Earthquake articles in Mineral Information Service, 1960-1970. 71-11
Gold refineries. 71-12

Possible sources of gold nuggets. 71-13
State geological surveys of the United States. 71-14
Index to the geologic atlas of California. 71-15
Smelters in the western United States. 71-16
Map of the California Division of Mines and Geology San Francisco District Office and surrounding area. 71-17
Some bookdealers handling out-of-print geological publications. 71-18
Mining legal forms. 71-19
Information for schools. 71-20
Facts about California's new strong-motion instrumentation program. 72-26

COOPERATIVE ACTIVITIES

The Division conducts a number of projects in cooperation with local governments, other State agencies, and federal agencies. The projects are designed to meet the need for information about actual or potential areas of geologic hazard or for information about mineral resources. Some of the projects are conducted to demonstrate the need for, and the usefulness of, geology to local government planning, building, and public works agencies. Other projects are conducted cooperatively to accelerate progress on existing Division projects or to enable the Division to begin projects sooner than could otherwise be done. Cooperative activities are funded jointly by the Division and the cooperating agency under various arrangements--the nature of which depends upon the availability of funds and personnel, the relative urgency of the project to the State and the cooperating agencies, and other factors.

COOPERATIVE ACTIVITIES WITH LOCAL GOVERNMENTS

Los Angeles County

The Department of the County Engineer and the Los Angeles County Flood Control District provide funds to accelerate the Division's geologic studies of the rapidly urbanizing areas of the county. Detailed geologic mapping was continued in the Oat Mountain 7 1/2-minute quadrangle (western San Fernando Valley). Field mapping was commenced in the Juniper Hills 7 1/2-minute quadrangle along the San Andreas fault. Publication processing was essentially completed for a Special Report on the area included in the east-central one-third of the Mt. Wilson and the south half of the Azusa 7 1/2-minute quadrangles.

In addition, the Division provided geologic services to the County in support of their HUD-financed Seismic Land Use Planning Study. Division staff mapped geology and seismic ground effects in detail in areas of the San Fernando and the Sunland 7 1/2-minute quadrangles affected by the San Fernando earthquake.

Orange County

The Department of Building and Safety, the Road Department, and the Orange County Flood Control District provide funds to accelerate the Division's geologic studies within the County. The Division began compilation of a 1:48,000-scale geologic map and a landslide occurrence map of the entire county. Detailed mapping was initiated in the Laguna Beach 7 1/2-minute quadrangle. The Dana Point and the south half El Toro 7 1/2-minute quadrangles are in review.

Santa Clara County

The Planning Department provided funds to accelerate the Division's geological studies within the County. A geologic study and slope stability evaluation of a 30-square-mile portion of the Santa Cruz Mountains was begun, and the field mapping was essentially completed during the 1971-72

Santa Clara County (continued)

fiscal year. The project area includes the active trace of the San Andreas fault. A brief evaluation was made of the mineral resources potential of the project area. The report completed by the Division in 1970-71 was published by the County.

Sonoma County

The Planning Department provided funds to accelerate the Division's geologic studies within the County. Detailed geologic mapping of the area along the Sonoma County coast from the mouth of the Russian River north to the Mendocino County boundary was completed during fiscal 1971-72. The report evaluated the relative hazards presented by mapped faults, seismic activity, and landslides and described the mineral resources potential.

Ventura County

The geological investigation of the south half of the county begun in late fiscal 1970-71 was completed in fiscal 1971-72. The project was cooperatively funded by the U.S. Geological Survey, the Ventura County Department of Public Works, and the Division. A geologic map at a scale of 1:48,000 was compiled in addition to a landslide map and a map and inventory of the mineral resources.

COOPERATIVE ACTIVITIES WITH STATE AGENCIES

California Polytechnic State University, San Luis Obispo

Under a continuing agreement, Cal Poly provides space for a Division San Luis Obispo Field Office so that geologic investigations in the southern Coast Ranges can be conducted more effectively.

California Department of Real Estate

Under a continuing agreement, the Division reviews subdivision applications at the request of the Department of Real Estate and determines if geologic conditions are such as to constitute a geologic hazard. A statement on geologic hazards is made where necessary, using available information; the statement becomes a part of the public report provided to the first purchaser of a lot in the subdivision.

California Department of Water Resources

Under terms of an interagency agreement, the Department of Water Resources prepared underground vaults for installing Division tiltmeter instruments along the San Andreas fault.

California Division of Highways

Under terms of an interagency agreement signed late in the fiscal year, the Division of Mines and Geology began the preparation of a series of maps of the entire state, depicting relative seismic hazards, for use by the Division of Highways in bridge design.

California State Lands Division

The interagency agreement with State Lands was continued. This agreement provides for partial funding of the marine geologist position in this Division in return for services which included studies of the sand and gravel deposits in San Francisco Bay, the distribution of mercury in offshore sediments, coastal erosion in Monterey Bay, and the collection, preparation, and interpretation of coastal and offshore geologic data.

State Water Resources Control Board and Regional Water Quality Control Boards

The Division continued to provide information and advice to the State and Regional Boards and to conduct investigations relative to reduction of pollution from mines and mine dumps in the interest of conserving mineral resources compatibly with water quality standards. Interagency agreements provided for a special study of the water-pollution problem relative to the Walker mine area in Plumas County and for the Division to supply the State Board with such information on all mines in California as might be significant with respect to water quality problems.

University of California at Berkeley

The Seismological Station provided the Division with detailed information on California earthquakes under the terms of a continuing agreement. The Division is notified by telephone of the location and magnitude of California earthquakes larger than Magnitude 5 in northern and central areas of the state so that an earthquake-response team may be deployed rapidly to evaluate potential geologic hazards in affected areas.

Other Cooperative Services

In addition to services furnished on a continuing basis, the Division provided a wide variety of short-term services to other State agencies upon request. These included the Public Utilities Commission, the Office of Planning and Research, the Office of Emergency Services, the Division of Oil and Gas, and the Department of Water Resources, among others.

In addition to the funded cooperative or contract projects, the Division participated in a number of interagency activities. A partial listing of the interagency groups on which the Division was represented during the fiscal year is as follows:

Advsiory Board to Strong Motion Instrumentation Program
Advisory Committee on Geographic Names
Advisory Group to Legislature's Joint Committee on Seismic Safety
Archaeological Study Task Force
Environmental Mercury Task Force
Geothermal Resources Board
Interagency Council on Ocean Resources Study Team
Land Use Study Committee (Office of Planning and Research)
Monterey Basin Pilot Monitoring Project Committee
Power Plant Siting Committee
Resources Agency Task Force on Tulare County
Salton Sea Study Committee
Technical Advisory Committee to Geothermal Resources Board
Technical Advisory Committee to San Francisco Bay Conservation and Development Commission

COOPERATIVE ACTIVITIES WITH FEDERAL AGENCIES

U.S. Department of Housing and Urban Development

The Division's California Urban Geology Master Plan project, financed in part through a comprehensive planning grant to the State Office of Planning and Research from the Department of Housing and Urban Development under the provisions of Section 701 of the Housing Act of 1968 as amended, progressed notably. Phase I of the three-phase project, commenced during fiscal 1970-71, was completed during fiscal 1971-72. A 494-page progress report, entitled "Urban Geology Master Plan for California Phase I: A Method for Setting Priorities", was prepared largely by Woodward-Lundgren and Associates, Frank McClure of McClure and Messinger, and Livingston and Blayney under contract to the Division. Phase II was begun and completed during fiscal 1971-72. Two draft manuscripts resulted from the Phase II studies. A 268-page manuscript was prepared by the Division in conjunction with F. Beach Leighton and Associates, summarizing the results of work item IIA. The objective of work item IIA was to test in several local areas the statewide criteria developed in Phase I for setting priorities for efforts to reduce the threat of loss because of geologic problems. A 154-page manuscript was prepared by the Division as a result of the studies for work item IIB. The objective of work item IIB was to prepare a draft of the Urban Geology Master Plan for California. Phase III to be carried out in fiscal 1972-73 will complete the project with the publication of the Plan.

National Oceanographic and Atmospheric Administration

The Division provided funds to NOAA for a cooperative first-order leveling project in the Imperial Valley for the early detection of possible subsidence due to future geothermal fluid withdrawal. Other cooperating agencies in the project were the Department of Water Resources, the Division of Highways, the Division of Oil and Gas, and the County of Imperial.

U.S. Bureau of Mines

The long-standing cooperative agreement between the Bureau and the Division concerning the collection of statistics of annual mineral production continued. The 1970 County production figures were published in the April 1972 CALIFORNIA GEOLOGY.

U.S. Geological Survey

The cooperative agreement for investigation of geology in California initiated in 1946 was continued. The Division provided limited financial support for U.S.G.S. investigations of the most recently active breaks along the Garlock, the Manix, the Big Pine, the Elsinore, the Sierra, and other active faults in California. U.S.G.S. cooperated with the Division in crustal strain measurements; it has assumed responsibility for measurements along the north half of the State Geodimeter Network in lieu of providing financial support as in previous years; the Division conducts measurements along the south half.

U.S. Geological Survey (continued)

The Geological Survey provided funds for the partial support of the Division's cooperative study with Ventura County in fiscal 1971-72.

The agreement for the Division to provide the Geological Survey with mineral resource information for the joint HUD-U.S.G.S. nine-county San Francisco Bay region environmental study was fulfilled and terminated at the end of fiscal 1971-72.

COOPERATIVE ACTIVITIES WITH OTHER ORGANIZATIONS

California Institute of Technology

Under a continuing agreement with the Seismological Laboratory, the Division provides funds toward the expense of performing services in connection with the recording and study of earthquakes in California. They provide prompt notification by telephone to Division geologists in the Los Angeles District of the location and magnitude of all southern California earthquakes larger than Magnitude 4.5.

OTHER COOPERATIVE ACTIVITIES

The Division continued to cooperate with Federal, State, County, and City agencies, universities and colleges, professional groups, private companies, and individuals without formal contracts or matching funds, often on an individual basis, by exchanging information on the geology and the mineral resources of California. Many of the activities listed elsewhere in this Report have been materially assisted by such cooperation. Examples of some of these cooperative activities are given here:

Access to libraries has been provided to Division staff by various California colleges and universities. University of California campuses at Los Angeles, Riverside, and San Diego (Scripps Institution of Oceanography) and the California Polytechnic State University campus at San Luis Obispo also provide office space.

The long-standing cooperation with the California Academy of Sciences continued with the Division's Senior Geological Scientist Charles W. Chesterman serving as the Academy's Honorary Curator of Minerals.

The Hancock Foundation of the University of Southern California, the National Science Foundation, the U.S. Marine Minerals Technology Center at Tiburon, the U.S. Geological Survey, and the California Department of Fish and Game cooperated in the Division's marine geology studies.

The Association of Engineering Geologists provided valuable assistance in evaluating the effectiveness of local governmental ordinances and practices in the application of geology to subdivision proposals.

A partial list of other informal cooperative activities with various organizations included the following:

Atomic Energy Commission: The Division provided information on the Cristianitos fault and slope stability and general geology of the San Onofre nuclear power plant area.

City of Hollister: The Division continued the informal cooperative study of creep along the San Andreas fault system in the vicinity of Hollister. The City provided trenching services.

City of San Luis Obispo: A Division geologist alerted the City Engineer to a moving landslide endangering several homes.

City of South Luguna Beach: Division geologists reviewed the City's general plan at the City's request.

Department of Finance: The Division provided California mineral production data for use in the Department's "California Statistical Abstract".

Department of Navigation and Ocean Development: The Division continued to provide assistance in the preparation of the California Comprehensive Ocean Area Plan.

Division of Forestry: A cooperative geophysical study of the Magalia district was undertaken to locate the deepest portion of the Tertiary river channel there for a potential water well site.

Division of Oil and Gas: The Division of Oil and Gas provided data for this Division's Ventura cooperative study, and this Division reciprocated by providing staff support to the geothermal studies of the Division of Oil and Gas.

Marin County: The terms of the 1972-73 agreement were negotiated. The County published the report of the 1970-71 cooperative studies.

National Aeronautics and Space Administration: The Division participated in the "Remote Sensing User Workshop" sponsored jointly by the Ames Research Center and the University of California.

Office of Emergency Services: Division geologists inspected the flash-flood area near Santa Barbara and advised the OES field office there on the potential for further slope stability problems. The Division also participated in the Simulation and Operations phases of the OES "Pearblossom" earthquake exercise in Los Angeles County

Power Plant Siting Committee: A Division geologist assisted in the preparation of a 20-year plan for power plant sites in California.

San Luis Obispo County: The Division supplied data on the mineral resources of the county; reviewed and provided geologic data for the proposed open space and conservation elements and geologic hazards section of the County's General Plan; and provided data on shoreline slope stability to the Tri-County (San Luis Obispo, Monterey, and Santa Cruz) shoreline study group.

Solano County: Information on the mineral resources and potential mineral resource areas of the County were provided to the Planning Department.

Stanislaus County: The Division assisted the County Planning Commission in evaluating a hillside area proposed for development and furnished the County Department of Public Works with data relative to a proposed land fill site.

State Senate: The Division prepared the hazardous mine excavation section of a Resources Agency response to Senate Resolution 144 requesting a study of various kinds of hazardous excavations. A response to Senate Concurrent Resolution 89 (1971) concerning a proposed State Mining and Minerals Policy was prepared by the Division in concert with the Mining and Geology Board and was approved by Director Stearns and Secretary Livermore.

U.S. Bureau of Reclamation: The Division provided geologic information pertaining to the areas around the Auburn and Folsom Dams and the proposed New Melones Reservoir.

BUDGET SUMMARY

An apparent decrease in the total net expenditure ($1,385,564) for 1971-72 over the prior fiscal year ($1,414,114) is due to the inclusion of certain reimbursements which were not previously considered. The cost of operating the Division, in the form of salaries and operating expense, amounted to $1,684,633 as compared to $1,616,623 for the prior year. The increase, which amounted to slightly more than 4 percent, was due in part to inflationary increases and in part to an increase in activities related to Division seismic studies. The relatively low rate of increase reflects continued improvement in efficiency during the second year of operation under the revised Division organization.

	Expenditure
Salaries	$1,155,619
Operating Expenses	529,014
General expense	$ 31,562
Printing	91,780
Radio	1,441
Communications	25,167
Travel, out of state	972
Travel, in state	32,381
Motor vehicle operation	24,703
Boat operations	733
Rent, facilities	155,524
Rent, equipment	510
Rent, aircraft	0
Consulting services	125,028
Technical reports	1,091
Facility maintenance	6,543
Engineering reproduction	18,790
Laboratory expense	5,252
Library services	63
Specialized training	114
Data processing systems	2,788
Expendable property	4,572
Equipment	43,258
Cooperative Program with U.S. Geological Survey	2,500
Reimbursements	-344,827
TOTAL NET EXPENDITURE	$1,385,564

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THE FUTURE

The Division will continue to accelerate its earthquake-related geologic and seismologic activities. The need to do so is clearly evident from the Division's own studies; from the recommendations of the Governor's Earthquake Council and the Legislature's Joint Committee on Seismic Safety; and from the increasing number of requests for seismic information by local government, by other State agencies, and by the private sector.

The capability to increase these activities will be augmented during the coming year by re-allocation within the Department. Further modest augmentation will be requested for 1973-74. The expansion of Division capabilities in seismology and earthquake hazard geology in recent years has been achieved primarily by re-allocation of Division administrative support positions as made possible by reorganization. Additional internal shifts cannot be made without adversely affecting the over-all program of the Division.

The Urban Geology Master Plan study will be completed in the coming year. From this document, the Division will develop its own intermediate- and long-range geologic hazards programs. Late in the coming fiscal year, a start should be made on the development of a longer range mineral resources program to supplant the interim two-year program developed during the past year.

The organizational and initial planning phases of the State Strong-Motion Instrumentation Program were completed in the past year. Acquisition and installation of accelerographs will be the major effort in this program in the coming year; a goal of 40 installations has been set for this period.

The telemetry system for the Division's tiltmeters should become operational next year.

The bottom lithology map of offshore California should be in press during the coming year.

The number of interagency contracts is expected to increase in the future. The demand for more geologic information parallels the growth of recognition of the need and uses for applied geology in the activities of Man on his planet.

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